Tension between every day and scientific views

Every specialized kind of human activity, every subject area and field—whether it's serving in Congress, refereeing baseball, designing handbags, or doing science—has its own special language and ways of talking. The language of science (or technology, engineering, and mathematics) is a good example of specialized language, not only because of its use of specific disciplinary definitions, but also because of the way the discipline is spoken and written using idiosyncratic terms, meanings, and sentence structure. Learning STEM requires understanding the disciplinary views and speaking the language of discipline, which educators need to model for learners.

However, there is usually a tension between directing the conversation to communicate the views of science and allowing learners to voice their views and be equal contributors to the conversation (*1*). The opportunity for learners to talk and share their thinking is necessary for learning. But learners' understanding, their everyday views, and the language they use to articulate their thinking often do not align with scientific views and the language of science. This misalignment shouldn't be surprising since learners are still grappling with the ideas, including how to talk about the ideas using language from the discipline.

The fundamental point here is that meaningful learning requires learners to make connections between their own ideas and the disciplinary views. Learners need the opportunity both to articulate their everyday ideas and to apply and explore newly learned disciplinary ideas for themselves, through talk and other actions.

1. Teaching Purpose

The teacher introduces and develops the scientific story (the scientific explanation and how it was arrived at) in a social context, in which students explore ideas together, before students individually internalize those ideas (*1*). In thinking about a class session (or series of sessions) intended to teach a topic, it is important for the teacher to explicitly consider and determine, "What am I trying to achieve here? What is my teaching purpose?" Within an individual lesson, the session might be divided into phases with different activities (e.g., lecture, small group solving problems) and addressing different teaching purposes that together support the learning goals of the session and/or unit. Potential purposes:

- Activate prior connections
- Give information
- Check for understanding
- Express your thoughts
- Transfer understanding

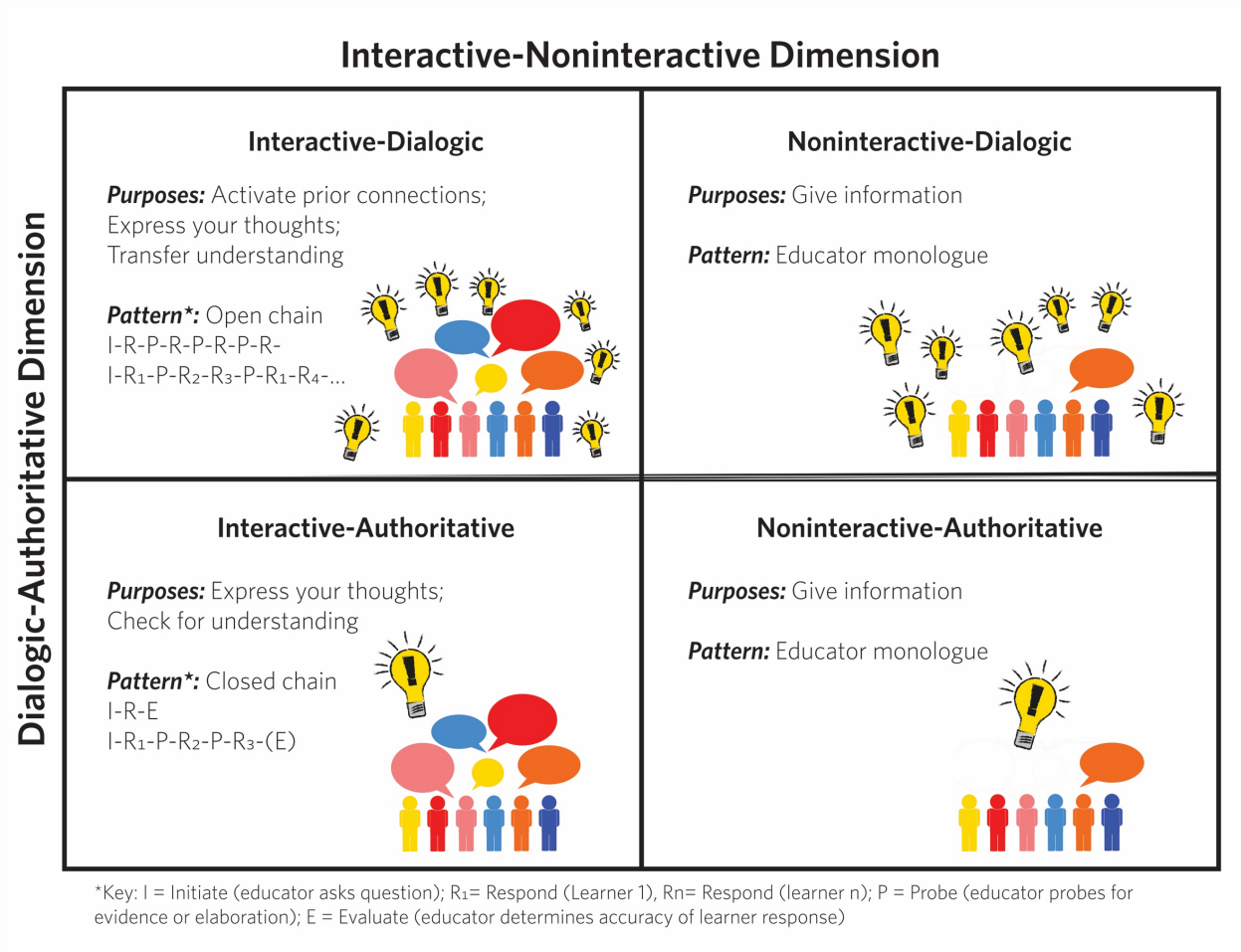
Key question: What purpose(s) is served, regarding the science being taught, by this phase of the lesson?

2. Facilitation approach

The facilitation approach refers to the ways in which the instructor orchestrates the exchange of ideas that emerge during the lesson. Changing the approach can help to alleviate the tension between every day and disciplinary language, as well as ease the power relation for students to co-construct knowledge in their learning community.

- There are two dimensions: *Interactive-Noninteractive* and *Authoritative-Dialogic*. These dimensions intersect to form four classes: Interactive-Authoritative, Interactive-Dialogic, Noninteractive-Authoritative, Noninteractive-Dialogic.
- The Interactive/Noninteractive dimension refers to the extent to which the conversation allows for participation from more than one person (interactive), or only one person, usually the educator (noninteractive).
- The Authoritative-Dialogic dimension refers to the extent to which the conversation privileges one idea (authoritative) or invites many ideas (dialogic). It's important to understand that the educator may still be facilitating the conversation along both ends of this dimension, but the number of ideas privileged changes.

Key question: How does the teacher work with the students to address the diversity of ideas present in the class during this phase of the lesson?



*Key: I = Initiate (educator asks question); R_1= Respond (Learner 1), Rn= Respond (learner n); P = Probe (educator probes for evidence or elaboration); E = Evaluate (educator determines accuracy of learner response)

3. Patterns of talk

The facilitated conversations are visible through the pattern of talk that emerges. Patterns refer to the turn-taking in a conversation, specifically who is talking and what they are saying.

- **Monologue.** Long speech by one person during a conversation. There may be little to no exchange between participants in the conversation.
- **Closed chain.** There is an exchange between participants in the conversation. The chain is closed if it ends with a final evaluation from the teacher (I-R-P-R-P-R-E). I stands for "Initiate," R stands for "Response," P stands for "Probe," and E stands for "Evaluation." Typically, the teacher initiates and evaluates the student's response, and then starts the sequence again with another question. The three-part exchange structure (I-R-E) without probing students for clarification, elaboration, or explanation is the most prevalent closed chain in science classroom conversations.
- **Open chain.** The exchange between participants in the conversation remains open because there is no final evaluation (I-R-P-R-P-R-). There may be multiple students responding (I-R1-R2-R3-P-R4).

Key question: What are the patterns of interaction that emerge in the discourse as teacher and students take turns in classroom talk?

References

1. P. H. Scott, E. F. Mortimer, O. G. Aguiar, The tension between authoritative and dialogic discourse: A fundamental characteristic of meaning making interactions in high school science lessons. Science Education 90, 605-631 (2006).